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Energy efficiency in resource planning

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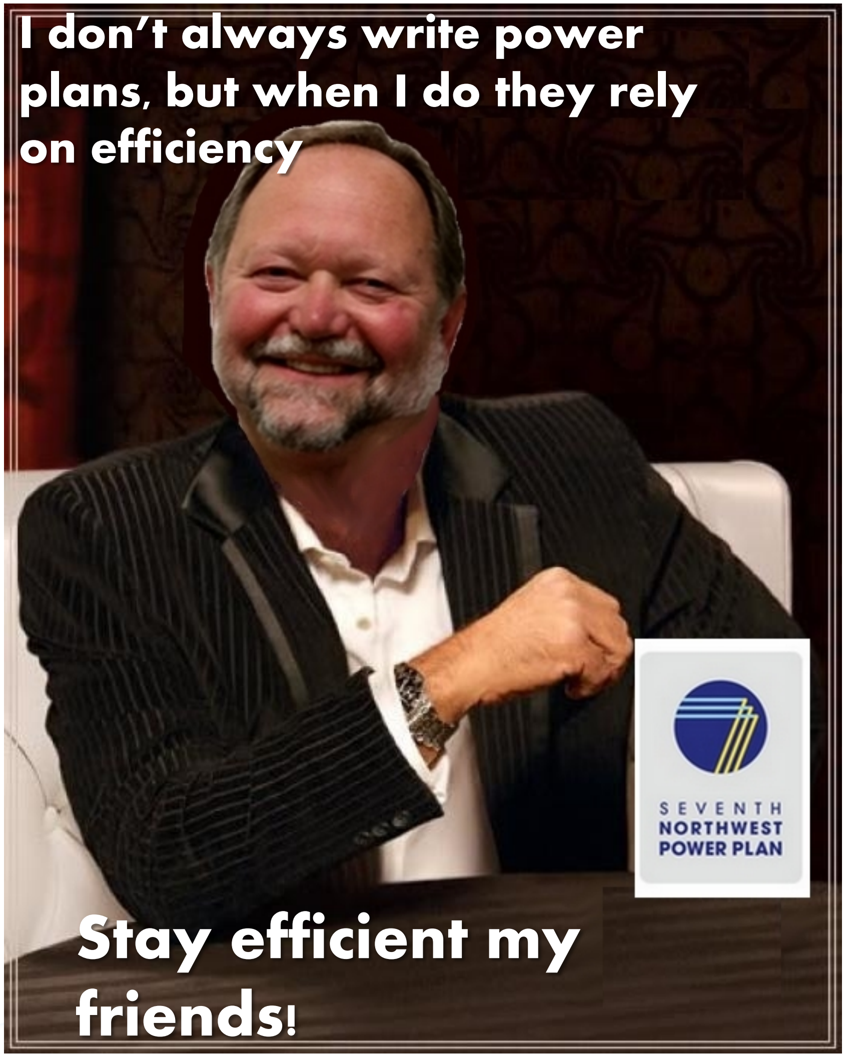

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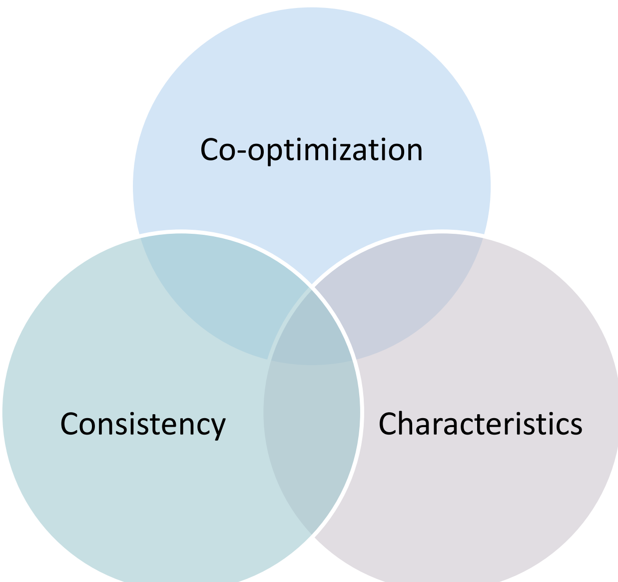
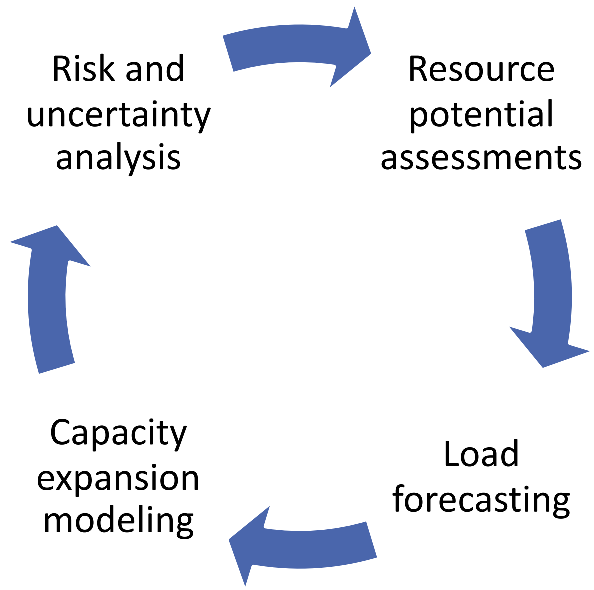
Additional contributions by Alan Sanstad, Lisa Schwartz and Greg Leventis.

Topics to cover

Three Principles to Consider in Resource Planning



Four Phases of Resource Planning



Examples

PacifiCorp

Seventh Northwest Power Plan

Indiana Michigan Power

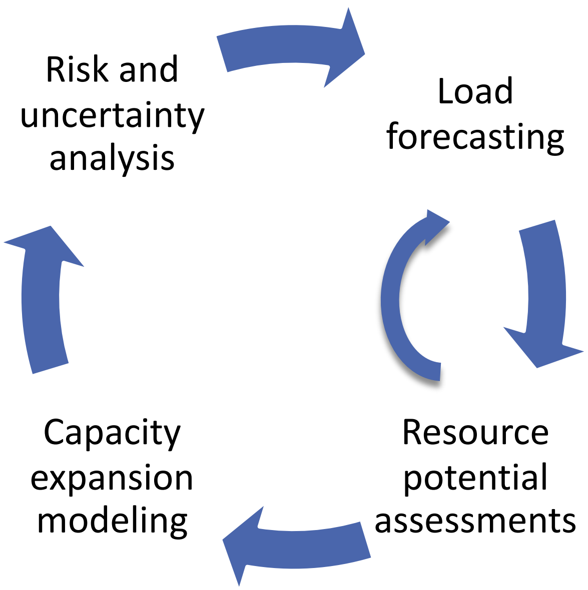
Three principles to consider

- **Co-optimization**: Efficiency is selected in in the capacity expansion modeling on par with generating resources, rather than simply reducing load forecast inputs.

- **Characteristics**: Efficiency is compared directly to generating resources based on economic and other resource characteristics (e.g., construction lead times and schedule flexibility, load shape, dispatchability, reliability, forced-outage rates, emissions, fuel and market price risks).

- **Consistency**: Efficiency levels and realistic achievable potential are based on paying up to the full incremental cost of measures, similar to funding generating or transmission and distribution facilities.

Four phases of resource planning



- Treating efficiency as a resource alters the methods, models and practices in resource planning

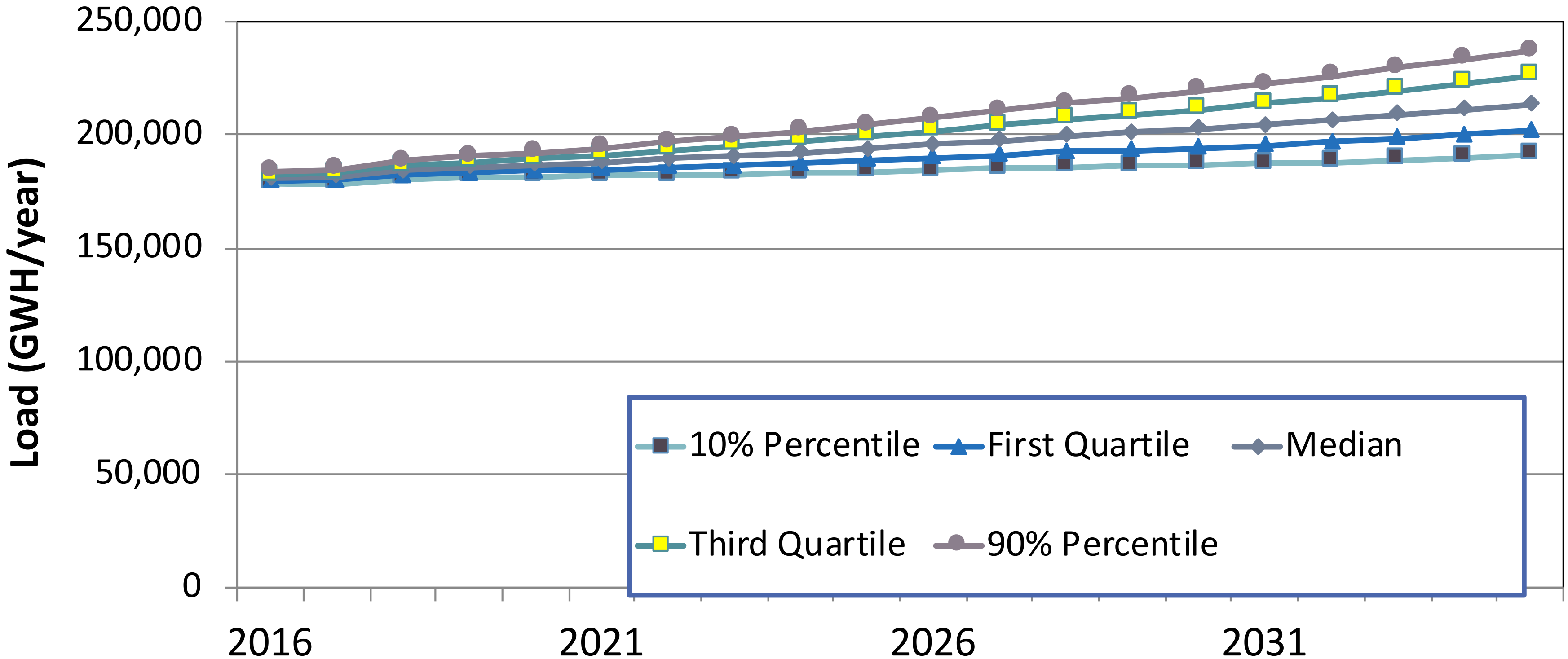
Role of load forecasting

- Load forecasts are the foundation of resource planning.
- Electricity load forecasts predict electricity consumption and peak load.
- They are used by planners as a basis for understanding future electricity needs and developing plans to meet the demand.

Changes to load forecast

Typical current practice		Potential improvement
Focus on a single forecast	→	Establish a *range* of future states
Rely on historic forecast to capture the impacts existing policy going forward	→	Incorporate the impact of known policies (e.g., standards and codes)
Use inconsistent inputs in planning processes	→	Align load forecast and resource assessment inputs (e.g., number and type of buildings)
	→	Use load forecast outputs as inputs to efficiency potential assessment and capacity expansion model

Load forecast **before** adding new efficiency acquisition



Source: 7th Northwest Power Plan – Baseline load forecast range without new efficiency

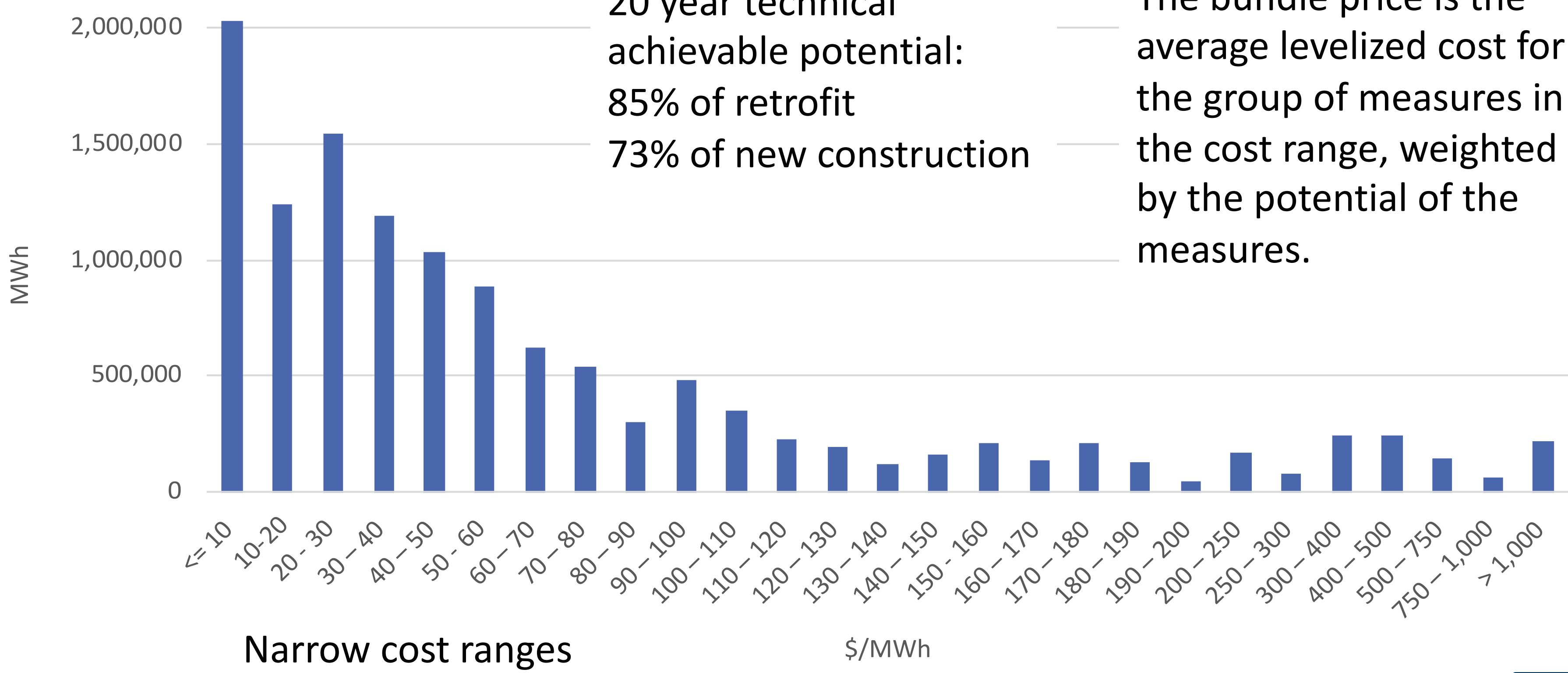
Role of efficiency resource potential assessment

- The objective of efficiency resource potential assessments is to provide accurate and reliable information on:
  - Quantity available
  - Timing of availability (e.g., new construction, stock turnover)
  - Cost
  - Load shape

Changes to resource potential assessment

Typical current practice	Potential improvement
Reduce load forecast to account for efficiency	Develop efficiency supply curves using the same types of economic and other resource characteristics
Limit efficiency incentives to a portion of incremental cost	Acquire efficiency up to a cost equal to their value in the electricity system.
Determine economic potential independently of capacity expansion model	Economic potential determined using resource optimization modeling process

PacifiCorp 2017 IRP energy efficiency supply curves



20 year technical achievable potential:
85% of retrofit
73% of new construction

The bundle price is the average levelized cost for the group of measures in the cost range, weighted by the potential of the measures.

Narrow cost ranges

Role of capacity expansion models

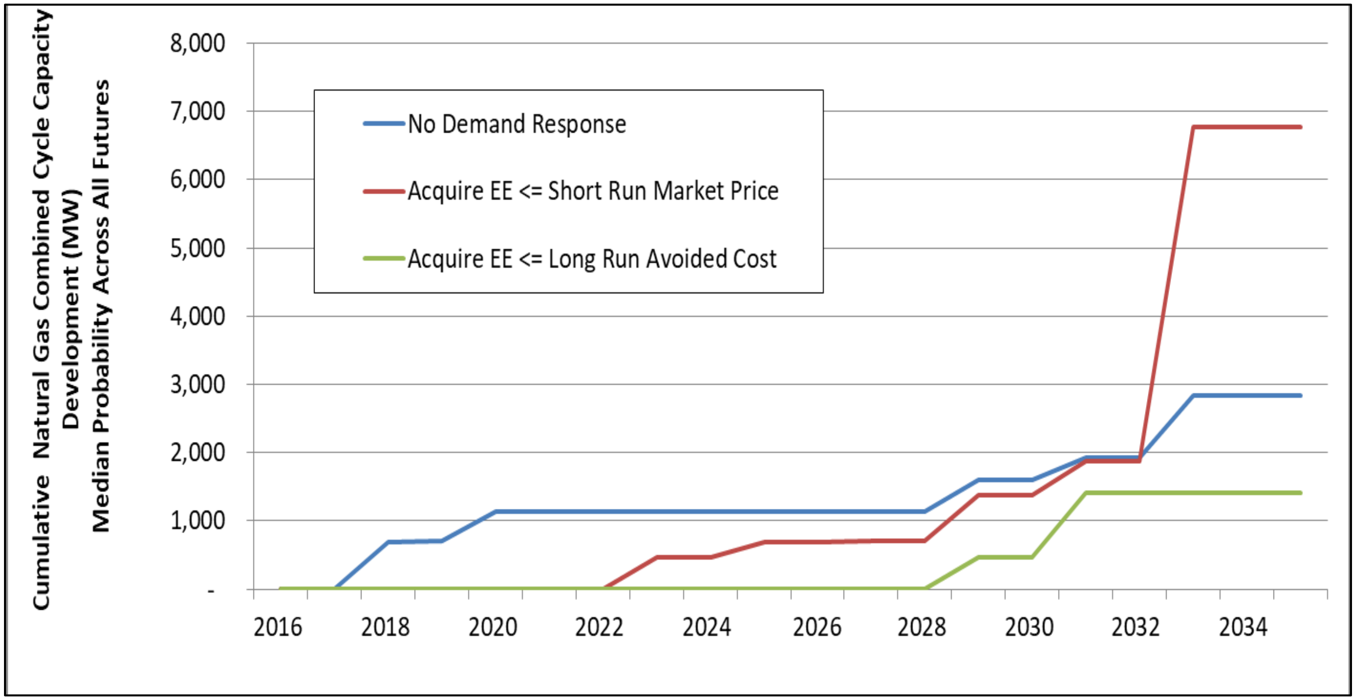
What they do	What they don't do
▫ Test alternative resource mixes and development timing (a.k.a., *Resource Strategies*) against a range of future conditions (e.g., load growth, natural gas prices, emissions costs/limits, etc.) ▫ Identify the "least cost" *Resource Strategy* and may or may not account for "risk"	▫ Determine what is an acceptable level of "cost" ▫ Determine what is an acceptable level of "risk" ▫ Decide which *Resource Strategy* is "Preferred"

Changes to capacity expansion modeling

Typical current practice	Potential improvement
Determine economic levels of efficiency outside capacity expansion model	Use efficiency supply curves to allow model to select efficiency as a resource
Do not allow for efficiency potential to change based on economic growth	Consider lost opportunity resources and economic growth
Cannot stop and restart efficiency programs	Assume programs delivery is flexible
Does not test ability of efficiency to cost-effectively meet future load (with a longer-term view, additional efficiency may be cost-effective)	Acquire efficiency in advance of need

Price Taker versus Price Maker

- Wide-scale deployment of efficiency will alter the type, timing and development of other types of resources.
- When EE is a resource, it is a “price maker,” not “price taker.”



Impact of demand response and efficiency acquisition on the timing and amount of natural gas combined cycle capacity development in the Northwest

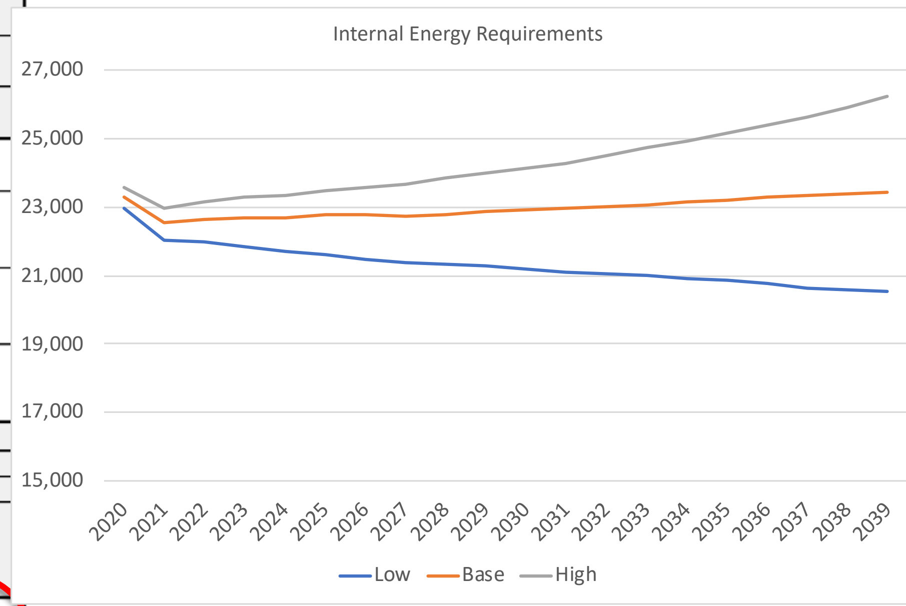
Risk and uncertainty analysis

Typical current practice		Potential improvement
Use perfect foresight in capacity expansion modeling	→	Use stochastic analysis* to consider resource risk and uncertainty
Do not consider intrinsic resource characteristics	→	Consider efficiency characteristics when evaluating risk
Do not consider inherent uncertainty in future conditions	→	Consider multiple futures in risk analysis

*Stochastic analysis uses random changes in key variables to simulate possible future conditions to test alternative resource portfolios. The process identifies the *most likely* outcomes and a *range* of possible outcomes.

Indiana Michigan Power 2018-2019 IRP: Optimized Portfolios and Load Forecast

	Type	Name	Commodity Pricing Conditions	Load Conditions
Group 1	**Group 1** Commodity Pricing Scenarios	1. Base - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)	Base	Base
		2. High Band - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)	High Band	Base
		3. Low Band - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)	Low Band	Base
		4. No Carbon - (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)	No Carbon	Base
Group 2	**Group 2 & 2A** Rockport Scenarios Includes Storage & MiniGrid	5. Case 5 & 5A (RP1 Retires 12/2028; RP2 Lease Expires 12/2022)	Base/No Carbon (A)	Base
		6. Case 6 & 6A (RP1 FGD 1/2026 & Retires 12/2044; RP2 Lease Expires 12/2022)	Base/No Carbon (A)	Base
		7. Case 7 & 7A (RP1 FGD 1/2029 & Retires 12/2044; RP2 Lease Expires 12/2022)	Base/No Carbon (A)	Base
		8. Case 8 &8A (RP1 Retires 1/2025; RP2 Lease Extended, FGD 1/2029, & Retires 12/2048)	Base/No Carbon (A)	Base
Group 3	**Group 3** IRP Scenarios Includes Storage & MiniGrid	**9. Transitional** (RP2 Lease End 2022, RP1 Retire 12/2028)	Base	Base
		10. 12 - Year Peaking (Post RP2 Lease End)	Base	Base
		11. 15 - Year Peaking (Post RP2 Lease End)	Base	Base
		12. Case 12 & 12a 12 - High Renewables - Peaking 12a - High Renewables - Peaking and CC	Base	Base
Group 4	**Group 4** Load Scenarios	**13. Low Load**	Base	Low
		14. High Load	Base	High
		15. Low Load	Low Band	Low
		16. High Load	High Band	High
Group 5	**Group 5** Other Scenarios	**17. EE Decrement Method**	Base	Base
		18. Unconstrained Wind and Solar Additions	Base	Base
		19. Reserve Margin Constraint with unconstrained Renewables	Base	Base



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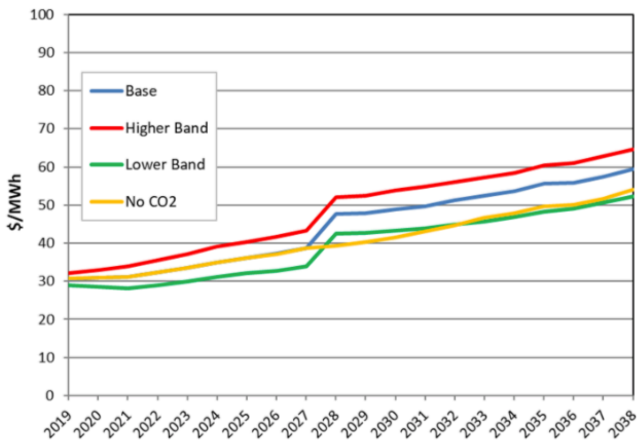
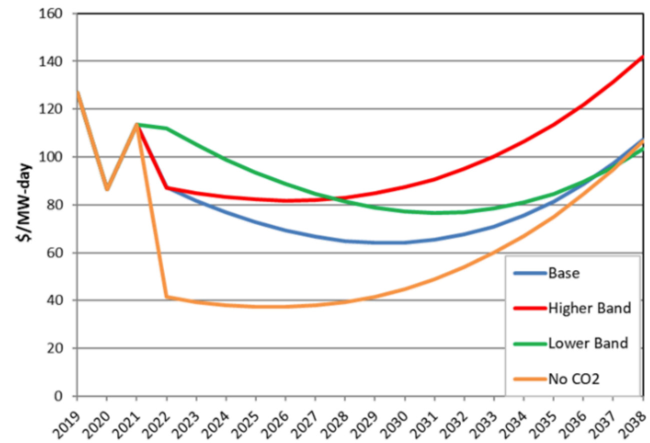
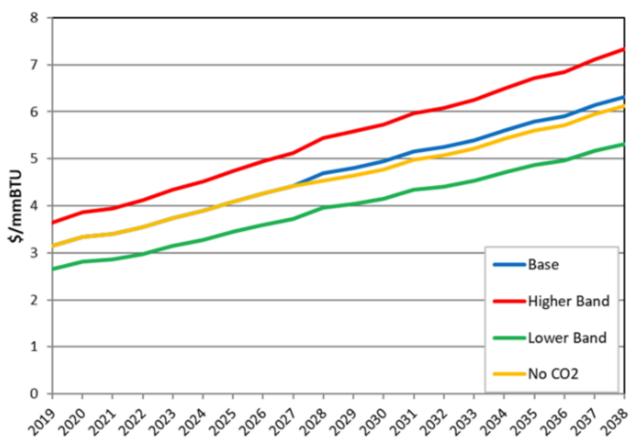
Indiana Michigan Power 2018 -2019 IRP: Commodity Pricing



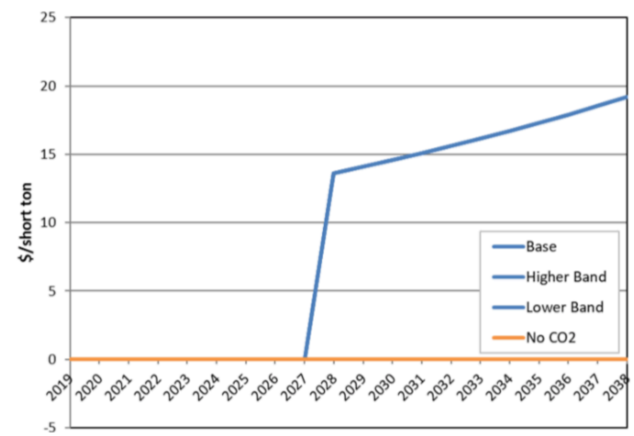
PJM on-peak energy prices (nominal $/MWh)



PJM capacity prices (nominal $/MW-day)



Delivered natural gas price (nominal $/mmBTU)



Carbon dioxide prices (nominal $/short ton)

Select resources and related research

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- End-Use Load Profiles for the U.S. Building Stock
- Electricity Markets and Policy energy efficiency research
- Time and locational sensitive value of efficiency
  - Time-varying value of electric energy efficiency (2017)
  - Time-varying value of energy efficiency in Michigan (2018)
  - No Time to Lose: Recent research on the time-sensitive value of efficiency (webinar)
  - Locational Value of Distributed Energy Resources (forthcoming)
- Peak Demand Impacts from Electricity Efficiency Programs (forthcoming)
- Energy Efficiency in Electricity Resource Planning (forthcoming)

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